

- to wildlife and recreation symposium (A. O. Haugen, ed.). Iowa State Univ., Ames, Iowa.
- BUMP, G., R. W. DARROW, F. C. EDMINSTER, AND W. F. CRISSEY. 1947. The Ruffed Grouse: life history, propagation, management. New York Conserv. Dept., Albany, New York.
- FORMOZOV, A. N. 1946. Snow cover as an environmental factor and its importance in the ecology of mammals and birds. Materials for fauna and flora USSR, New Series, Zoology 5:1-152. Moscow Soc. Naturalists, Moscow, USSR. (English translation by W. Prychodko and W. O. Pruitt, Jr. Occas. Papers 1, Boreal Inst. Northern Studies, Univ. Alberta, Edmonton, Canada.)
- GRINER, L. A. 1939. A study of the Sage Grouse (*Centrocercus urophasianus*), with special reference to life history, habitat requirements, and numbers and distribution. M.S. thesis, Utah State Univ., Logan, Utah.
- GULLION, G. W. 1970. Factors influencing Ruffed Grouse populations. Trans. No. Am. Wildl. and Nat. Resour. Conf. 35:93-105.
- IHLI, M., P. SHERBENOU, AND C. W. WELCH. 1973. Wintering Sage Grouse in the Upper Big Lost River. Idaho Acad. Sci. 9:73-80.
- IRVING, L. 1960. Birds of Anaktuvuk Pass, Kobuk, and Old Crow. U.S. Natl. Mus. Bull. 217.
- KUZMINA, M. A. 1961. Adaptation of *Tetraonidae* and *Phasianidae* to climatic conditions. Trans. Inst. Zoology 15:104-114.
- PATTERSON, R. L. 1952. The Sage Grouse in Wyoming. Sage Books, Denver, Colorado.
- RASMUSSEN, G. AND R. BRANDER. 1973. Standard metabolic rate and lower critical temperature for the Ruffed Grouse. Wilson Bull. 85:223-229.
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Size of host egg and egg size in Brown-headed Cowbirds.—The North American Brown-headed Cowbird (*Molothrus ater*) is a brood parasite that lays its eggs in a variety of other birds' nests. Cowbirds exhibit variation in egg size both within and among females (Ankney and Johnson 1985), but it is unknown if this variation follows predictable intraclutch patterns as it does in some icterines (Howe 1976, Weatherhead 1985). Several studies on a variety of species have shown that the probability of survival of a particular hatchling increases with egg size or hatchling weight (e.g., Parsons 1970, O'Connor 1979). Here I report the results of a study aimed at determining whether cowbird egg size varies as a function of host egg size.

I measured cowbird eggs in 143 clutches parasitized with one or two (total 168) cowbird eggs in the collections of the Royal Ontario Museum, the National Museum of Canada, and Cornell University. Nests with more than two cowbird eggs were not used as they were assumed to be dump nests (Harrison 1975). Egg sets came from Ontario and Quebec (78%), the northeastern United States (13%), and the Canadian prairie provinces (9%). Although the last group probably included individuals of the race *artemisiae*, they showed no difference in mean size from those of the nominate race. The egg sets were from 42 species of seven families.

I measured length (L) and breadth (B) of each egg to the nearest 0.05 mm and used κLB^2 as an estimator of egg volume, where κ is a constant derived from empirical studies. For cowbirds ($\kappa = 0.515$; Nolan and Thompson 1978), the largest egg was 1.63 times greater than the smallest. For host eggs ($\kappa = 0.524$; Romanoff and Romanoff 1949:108), the largest egg was 4.78 times greater than the smallest.

There was no indication of a correlation between the estimated volumes of cowbird and host eggs ($P > 0.01$), nor was there a correlation between cowbird egg volume and host weight ($P > 0.01$). I also estimated the volumes of host nests using dimensions given in Harrison (1975); I used $\frac{1}{2}(4/3)\pi r^3$ (where $r = [\text{depth} + \text{diameter}]/3$) as an estimator of nest volume. There was no relationship between cowbird egg size and host nest volume ($P < 0.01$) for the 32 host species for which estimates were possible (142 eggs).

Variation in egg size may be imperfectly predictable to the laying cowbird, and other factors such as environmental conditions (Ankney and Johnson 1985), nutritional state and clutch size (Howe 1976), and age (Blank and Nolan 1983) may also affect the size of eggs laid. Furthermore, the utility of egg size variation predictability may be secondary to the availability of hosts for any one laying event.

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LITERATURE CITED

- ANKNEY, C. D. AND S. L. JOHNSON. 1985. Variation in weight and composition of Brown-headed Cowbird eggs. *Condor* 87:296–299.
- BLANK, J. L. AND V. NOLAN, JR. 1983. Offspring sex ratio in red-winged blackbirds is dependent on maternal age. *Proc. Natl. Acad. Sci. U.S.A.* 80:6141–6145.
- HARRISON, H. H. 1975. A field guide to birds' nests. Houghton Mifflin, Boston, Massachusetts.
- HOWE, H. F. 1976. Egg size, hatching asynchrony, sex, and brood reduction in the Common Grackle. *Ecology* 57:1195–1207.
- NOLAN, V., JR. AND C. F. THOMPSON. 1978. Egg volume as a predictor of hatchling weight in the Brown-headed Cowbird. *Wilson Bull.* 90:353–358.
- O'CONNOR, R. 1979. Egg weights and brood reduction in the European Swift (*Apus apus*). *Condor* 81:133–145.
- PARSONS, J. 1970. Relationship between egg size and post-hatching chick mortality in the Herring Gull (*Larus argentatus*). *Nature* 228:1221–1222.
- ROMANOFF, A. L. AND A. J. ROMANOFF. 1949. The avian egg. Wiley, New York.
- WEATHERHEAD, P. J. 1985. Sex ratios of Red-winged Blackbirds by egg size and laying sequence. *Auk* 102:298–304.

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